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AUTHOR Jost, Karen Lee; And Others
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ABSTRACT

Project-based and problem-based learning are instructional methods that are being used to promote active and authentic learning. A graduate education course was first implemented using a project-based approach. The second time the course was offered, problem-based learning (PBL) using the Barrows (1988) tutorial process was used. The participants were graduate education students enrolled in an elective course. This paper analyzes the two offerings of the course to compare the differences between the two learning methods. Research questions focus on: student outcomes--knowledge, skills, process, and attitude; classroom strategies and interactions; types of objectives supported; student collaboration; use of technology; and issues that arise when using the methodologies in graduate courses. The study provides data which supports the use of problem-based learning in the higher education classroom. The study also provides factors to consider when designing active learning environments by comparing the different types of objectives that are best met by either problem-based learning or project-based learning. (SWC)

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ED 409 840

A Study of Problem-Based Learning in a Graduate Education Classroom

Karen Lee Jost
California State University, Chico

Byron C. Havard
AT&T

Andrew J. Smith
Georgia State University

Theoretical Perspectives

Leaders in education, business, research and government have emphasized the need to rethink our goals for education. Concurrent with the redefinition of educational goals is the emergence of new assumptions about learning and instruction. Schools are responding by creating information-rich environments for instruction and administration utilizing technology as the vehicle for restructuring education to meet the needs and challenges of our information society.

These rich environments promote active knowledge construction in authentic and meaningful contexts. They also encourage students to assume a more responsible role in their own learning (Grabinger & Dunlap, 1994); support the development of collaborative decision-making and problem-solving; and foster the development of research and meta-cognitive skills. Social interaction is an important component in these environments, supporting cognitive development (Vygotsky, 1987; Wertsch, 1985). This approach stresses the process of learning, including the important component of reflection, rather than the learning of content alone. This philosophy is consistent with preparing students to work and live in a technological society.

Project-based (Honebein, Duffy, & Fishman; 1993) and problem-based learning (Savery & Duffy, 1994) are instructional methods which are being used to promote active and authentic learning. A graduate education course was first implemented using a project-based approach. The second time the course was offered, problem-based learning (PBL) using Barrows (1988) tutorial process was used.

Research Questions

The questions which focused this study included:

I. What are the differences in:
   1. Student Outcomes
      a. knowledge, skills, process
      b. attitude
   2. Classroom strategies/interactions
   when using project-based versus problem-based learning in the classroom.

II. What types of objectives does each method support?

III. How is student collaboration supported by each methodology?

IV. How did technology support each methodology?

V. What issues arise when using these methodologies in graduate courses?

Methods

The participants were graduate education students enrolled in an elective course. The course met once a week for 4 hours and 40 minutes, over a quarter. One class met in a College of Education computer lab. The PBL class met in the Instructional Resource Center.

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The first quarter the course was taught using an inquiry-oriented, project-based approach with students working in collaborative groups. The class worked on three main projects with individual groups choosing the focus for their inquiry. The projects included the investigation of curricular frameworks and educational goals; research on both new forms of assessment compatible with evolving educational goals and learning theory, and ways that technology can support assessment; and the investigation of current and emerging uses of technology within an area of interest. In addition, students critiqued learning activities that had a technology component, and educational software. Students were presented with a choice from four possible final projects or they could propose an alternative project of their own.

Students critiqued their own group's process and other groups' projects. Questionnaires were used, not only to collect data on process and for purposes of grading, but to also support student reflection. All of the data was electronically collected through the use of hypermedia, word processing, or email. Students were required to keep both a journal and a portfolio.

The course was also conducted using a problem-based learning (PBL) approach using Barrows (1988) tutorial process. A HyperCard stack was developed to record student information including their backgrounds, interests, and views on learning and technology. The tutorial sessions were first offered using flip charts. Software tools were then designed to help facilitate the tutorial sessions, students' self-directed study, and the facilitator's role.

The class worked on three problems during the quarter, two with the class and one in small groups. The students used email and the internet extensively. They shared and critiqued resources, kept journals, and evaluated their own problem-solving, self-directed learning, and support of the group process. In addition students critiqued a technology-supported learning activity. Students were again given a choice of final projects, and could choose whether to work individually or in groups.

Data was collected through observation, questionnaires, documents such as journals, self and group evaluations and email, and artifacts (student projects and portfolios). QSR NUD•IST was used to facilitate the analysis of the data.

Results

Student Outcomes

Students' views of their learning was evidenced in their journals, self-evaluations, and exit surveys. Students in both classes were at first uncomfortable, particularly concerning what was expected of them (their role/responsibilities) and how they would be evaluated. They all stated that they "learned a lot."

Student reflections on group interactions and participation were very consistent with the overall class activity. In the project-based class, students discussed their participation and group interactions in product-oriented terms. In the PBL class, students discussed their contributions in terms of ideas, information shared, and communication.

Students in the PBL class were instructed to email their self-evaluations to the professor, which were to include how they thought they did as a problem solver, as a self-directed learner, and how they might work differently the next time. Students reflected on the benefits of the problem-solving process that they were learning, and on problem-solving within a group. After the first problem, one student described a benefit of working as a member of a group:

> I felt that I gained many insights into how others would solve the same problem. That is very valuable when trying to force yourself to see things from another perspective because in most instances there is more than one right answer.

Another student described a benefit of working in groups over "traditional, teacher-based lecturing techniques":

> The opportunity for peer-taught input can really enhance the amount of information that can be passed along and assimilated.

An additional benefit of group work was described:

> I like collaboration and getting input from different people. It helps keep an open mind and make me think in various ways I might not have thought of before.

In evaluating their participation as a group member, a number of students in the PBL group mentioned their own communication skills and learning styles. Some students discussed that they felt "some initial anxiety" and that they were intimidated by group members who seemed to have more knowledge and experience that was related to the course.

A benefit of solving the problems that was described by students was learning to "understand the implied problem" and "deciding when I had enough information to answer the question."

Students discussed their attitude toward the course methodology. This included the problem solving process, relevance of the problems, and inquiry skills. Students stated that they experienced satisfaction in working through the problems. One student stated:

> The learning method we used ... is, to me, very intuitive. It is the way we learn things in the "real world." From language to a job task, when we become active participants in the context of that which we seek to learn, it becomes a part of us and not a memorized appendage to be regurgitated for an exam and discarded immediately thereafter. I like the cross-discipline nature of this learning process.

Classroom Strategies/Interactions

Students in the project-based course spent more time learning the software. Meeting only once a week to work together with the technology, limits the experiences and benefits of this model. The experience is different from the K-12 project-based classroom that meets daily. Students required that most of the class time be spent using the technology to complete projects. Time for discussion was, therefore, limited.

Group process was studied. The group work that was done in the project-based class was at first, collaborative in nature as students discussed possible topics, posed questions to one another, and made decisions concerning the tasks that they needed to accomplish. Some of the initial data gathering was also done in a collaborative manner. As the projects progressed, students began feeling that there wasn't enough time and some group projects were pieced together individual projects rather than true "collaborative" work. In addition, when given the choice of group or individual final projects, students chose to do individual projects. The resources that students used for their inquiry was very limited compared to the resources used by the PBL class. Students chose a narrow focus for their group projects. The driving goal was on producing a product rather than inquiry and learning.

In the PBL class the benefits of collaborating became apparent to students as they learned and experienced the process. Collaboration continued throughout the quarter.

The PBL class had more opportunity to discuss, apply, and synthesize the information contained in class readings and in the additional resources that they found and shared. The PBL process also supported inquiry better in terms of scaffolding the process and time (it is the focus of what students are expected to do between meetings).

The over-riding goal in the PBL-class was inquiry. Students not only learned about and used more resources, they also critiqued and shared resources with other students. The problem environment supported in-depth discussion of relevant topics and revisiting concepts and their relationships. The problems overlapped and built on each other. When given the choice of group or individual final projects, students in the PBL class chose to do group projects.

Both the projects and problems were designed so that students would "discover" important ideas on their own. This was done instead of "telling", in order to support conceptual change. Students enjoyed and learned in both classes but the students in the PBL environment displayed more ongoing and consistent motivation for both the class time and inquiry outside of class.

Objectives Supported

This class was originally designed to support conceptual change. The course design was consistent with a constructivist view of learning, new educational goals, and a view of the role of technology as a tool that can support the attainment of educational goals and increased student learning. The project-based class was designed to

model K-12 active learning environments where technology is used to support inquiry, to share group projects, and to support student motivation. The PBL class utilized Barrows tutorial method (Barrows, 1988).

Collaboration was an important aspect of these learning environments. The objectives of problem-based learning include developing and applying the following lifelong learning skills:

- reason through problems
- identify learning issues
- identify and use appropriate information resources
- support group process
- ability to evaluate the performance of self and others in a positive and constructive manner.

The students in the PBL environment both chose to collaborate and reflected on the benefits of collaboration more than students in the project-based class. This seemed to be in part due to the amount of time needed with the software and difficulties collaborating over a distance, on technology-based projects.

In the PBL course the requirement of self-evaluation supported the reflection necessary for metacognition and individual development as problem-solvers and independent learners.

With these students, the PBL problems and course structure both encouraged more extensive inquiry and appeared to provide more motivation than the projects.

Both classes were structured so that students would need to explore the same issues. The structure of the PBL class provided more group input and discussion and for a complex and interconnected domain, it scaffolded the required cognitive processes, better than the project-based learning approach.

Technology

Students used technology for communication, inquiry, and productivity. The PBL class used a facilitating stack with problems two and three. Students discussed the role of technology. They described both the benefits of electronic searches and frustrating experiences with software and the internet. The PBL group worked on problem three in small groups using a hypercard stack which was designed to facilitate the process. The reaction to the software was very positive. Students described its benefits as providing structure and organization and facilitating group participation. One student also noted:

> when using the software for these purposes, the computer becomes the focal point of the group. ... The computer almost becomes a facilitator in itself.

Issues

Students have "learned" traditional roles and feel anxious when they are not sure of what is expected of them and how they will be evaluated. In the PBL class, students were more confident and felt more successful as they progressed. Both understanding the process and having some additional background knowledge were cited as contributing factors. Students also preferred working in smaller groups with problem three. They realized, however, that their previous experience learning the process and the knowledge they acquired working on the first two problems, played a major role in their success and enjoyment with the third problem.

Time and schedules were also issues with both of these methodologies. The type of group work required of the project-based class also had the additional issue of technology access.

Inquiry was an important component of both classes. The amount of information, its accessibility, and evaluating sources, were issues that surfaced. Students are becoming overwhelmed by the amount of information that they somehow need to wade through.

Educational Implications

This study provides rich data which supports the use of problem-based learning in the higher education classroom. It also provides factors to consider when designing active learning environments, comparing the different types of objectives that are best met by either PBL or project-based learning.

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